

CHIRIDOTA, Esch.

1. *C. lævis* (*Holothuria*), O. Fabr. Greenland.
2. *C. violacea*, Peters. Mozambique.
3. *C. ? purpurea*, Less. Falkland Islands.
4. *C. lumbricus*, Esch. I. Radak, Coral Sea.
5. *C. discolor*, Esch. Sitcha, Russian America.

MYRIOTROCHUS, Steenstrup.

1. *M. Rinkii*, Stp. Greenland.

July 27, 1858.—Dr. Gray, F.R.S., V.P., in the Chair.

ON THE GEOGRAPHICAL DISTRIBUTION OF REPTILES.

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It was with great pleasure I read Mr. Sclater's paper "On the Geographical Distribution of the Members of the Class Aves," published in the 'Proceedings of the Linnæan Society,' February 1858. And again, in personal interviews with my friend on similar subjects I had often the satisfaction to agree with him in results he had gained from another part of the animal kingdom. But such gratifying results as we find in the aforesaid paper can only be obtained, not merely by an extended knowledge of the whole animal kingdom, but by a complete knowledge of the details of a separate portion of it; and the reason why all the attempts at a general account of the geographical distribution of animals are not satisfactory enough for the naturalist, is to be found in the circumstance, that the authors were not acquainted in the same degree with every part of the subject treated, as also from our limited knowledge of zoology. Thus I may follow the example of Mr. Sclater and give for the present only an account of the geographical distribution of those animals, to the knowledge of which especially I have latterly devoted myself; and often referring to that paper, I shall show how far I can agree with the general views contained therein, and whether these groups of the natural kingdom give us a division of the earth's surface into the same natural provinces.

PART I.

ON THE GEOGRAPHICAL DISTRIBUTION OF THE SNAKES.

Schlegel, as he first founded philosophical views in the knowledge of Snakes, first gave an essay on their geographical distribution, showing the exact locality of the species as far as was then possible. He however only pointed out the geographical areas over which the species extend,—certainly the first basis upon which a knowledge of the geographical distribution of the families and genera can be founded. But at that time the much more limited knowledge of specific forms obliged him to establish genera of too great extent; and in conse-

quence he could not bring, in a more or less accordant correspondence with a certain province of the earth's surface, those genera which are really peculiar to such a separated district. And although that sketch, with which the first volume of Schlegel's 'Essai' is concluded, deserves the more admiration, as this branch of science, not previously cultivated, was raised by him at once to a degree of philosophical view adequate to his system, it must share the destiny of every such attempt, when our knowledge of faunas as well as of geography is more advanced: many stated truths will hold good—a part or all the principles applied before will form the basis of the next attempt; but many other points will appear to be modified or wrong, and will be replaced by other results. For a better understanding, one may compare my view of the geographical distribution of Reptiles in Africa with that of Schlegel. In this attempt I have maintained his idea of *species*, but I think I have gained more general and more true results by more limited genera (far different from those "subgenera," which are in fact species) and by a modified view of the geographical regions. But we now also want far more correct information concerning the genera and families, before we can arrive at very satisfactory conclusions.

There is, in the first place, a much greater disproportion in the distribution of Reptiles over the different regions, with respect to the number of genera and species, as well as of individuals. Amphibian life is entirely different from that of the higher animals, being exposed to the slightest modifications of external physical influences; and there are again great differences among the Reptiles themselves. Let us compare some of our Snakes with Batrachians, in a few instances only. Frogs and Toads are found on the Shetlands, whilst *Vipera berus*, the most northern Snake, is already scarce in the north of Scotland. *Rana temporaria* is met with in the Alps round lakes, near the region of eternal snow, which are nine months covered with ice; whilst *Vipera berus* reaches only to the height of 5000 feet in the Alps, and of 7000 in the Pyrenees. A Triton or a Frog being frozen in water will awake to its former life, if the water is gradually thawed; I found myself that even the eggs of *Rana temporaria*, frozen in ice for seven hours, suffered no harm by it, and were afterwards developed. A Snake can only endure a much less degree of cold: even in the cold nights of summer it falls into a state of lethargy; it awakes late in the spring, when some Frogs and Tritons have already finished their propagation; it retires early into its recess in harvest, while the evenings still resound with the vigorous croaking of the Tree-frogs and the bell-like clamour of *Alytes obstetricans*. Our European Snakes die generally, in captivity, during the winter, partly from want of food, partly by the cold nights. The eggs of our oviparous species are deposited during the hottest part of the year, requiring a high temperature for development. Further, though some accounts of Batrachians enclosed in cavities of the earth or trees may be exaggerated, the fact is stated by men whose knowledge and truth are beyond all doubt, that such animals live many years apparently

without the supply of food necessary for preserving the energies of the vital functions \*. Dr. A. Smith himself was an eye-witness how several specimens of *Brachymerus fasciatus* were found in a lethargic state in a hole of a tree, completely closed, conspicuously open before and grown together afterwards. Such a tenacity of life is never to be observed in a Snake: the higher the temperature the greater is the need of food; and a Snake having endured fasting during six or nine months always dies. Moreover, the tenacity of life in the Batrachians is proved by their power of reproduction, which has never been observed in a Snake. If we add the fact that Snakes do not produce many eggs or young ones, that they are able to propagate only when several years old, that they incur continual dangers by their numerous enemies, and that they are deprived of the means of performing distant journeys, we must consider it as the natural consequence, that no species will spread so far as Batrachians. These are enabled to endure temporary physical disadvantages, to traverse localities without the regular supply for their life, and to make up yearly for the lost number by a numerous offspring. More or less confined to a fluid element, they are favoured by another agency for an easier spreading. But these facts are really applicable to a comparatively small number of species only; and the question why we do not find all these peculiarities equally exhibited in all the Batrachians or in a great part of them, is as difficult to be answered as why one species is richer in individuals than another: but it is remarkable that just those species which are spread over the widest range are also those distinguished by an intensity of individuals.

On the other hand, we find Snakes almost entirely limited to the original locality of the individual: but if the individuals are restricted to the soil which gave them birth, the whole group, formed by such individuals, is likewise stationary; and if there be different creations, corresponding to the different natural divisions of the earth's surface, such a group as the Snakes must be best adapted for proving it, because here the agencies are wanting by which a species or a genus is spread over a larger part of the globe in the course of time, thus becoming mixed with foreign forms.

After these preliminary remarks, I proceed to the special objects of our inquiry; and we shall then see what conclusions can be formed in comparison with those of the ornithologist †. According to the above-stated peculiarities of the life of Snakes, there is *no cosmopolitan species*, and we can find only a few examples where one and the same species extends over the borders of the neighbouring region (cf. p. 226, *Naja haje*, *Echis carinata*, *Zamenis ventrimaculatus*, and pp. 233, 234, some species ranging from the Nearctic region into the Neotropical, and *vice versâ*). Among the genera we do not find one

\* Cf. "Observations on the Common Toad, and on its long abstinence from food," by John Brown, Esq. (Ann. & Mag. Nat. Hist. 1842, vol. x. p. 180).

† As for the systematical denominations adopted, I refer to the 'Catalogue of Snakes' (*Crotalidæ*, *Viperidæ*, *Hydridæ*, *Boiidæ*) by J. E. Gray, London, 1849, and to my 'Catalogue of Colubrine Snakes in the Collection of the British Museum,' London, 1858.



true cosmopolitan genus. *Tropidonotus* is one of those which have the widest range, a genus containing about thirty well-known species, each of which bears natural characters so conspicuous, that its position in the system is not to be mistaken: they are not to be found in the Æthiopian region only; they are truly called freshwater Snakes, following the course of the rivers and the borders of lakes. Some of the species (*T. natrix*, *hydrus*, *quincunciatus*, *ordinatus*, *fasciatus*) have a very wide range within the borders of its peculiar region. A few of the Asiatic species exhibit slight modifications of the general appearance of the genus (*T. cerasogaster* and *vibakari*). The second genus, which may be almost called a cosmopolitan, is *Coronella*, being spread over the whole globe except the Indian region, where it is replaced by such modifications of the characters as to justify the separation of them into new genera—*Simotes* and *Ablabes*, sp. The latter, closely allied to *Coronella*, accompanies this genus, extending over all the regions, except over the Australian one. Thus, if I speak hereafter of cosmopolitan genera of Snakes, they are to be understood with the restrictions mentioned. The families of Snakes in the different systems are at present founded upon such general characters, that in most of them genera of some or of all the geographical regions are comprised; perhaps at some later period they will be limited to more contracted boundaries of less general characters, thus approaching more to the borders of the geographical regions. But for the present we cannot derive from them our deductions as to the primary creation of the natural regions of the earth's surface, as the ornithologist does; and we are obliged to confine our views to the genera: we have not even such families of Snakes as are peculiar to one of the two great geographical divisions, either to the old world or to the new, except those in which the characters of the family are identical with those of the single genus. This discrepancy between Ornithology and Herpetology may be caused by a different systematic treatment of the characters, and may be more reconciled in course of time; but there will always remain forms common to the new and old world. Therefore it is not possible to give a list of *Familie Neogeanæ* and *Familie Palæogeanæ* (cf. *Slater*, l. c. p. 133).

But I may here give an account of such genera as, I think, will still long remain examples of forms common to the new and old world (cosmopolitan genera excepted): they are *Rhabdosoma*, *Columber*, *Spilotes*, *Coryphodon*, *Cyclophis*, *Philodryas*, *Dipsas*. I could add as many other genera; but I think such genera as *Rhinostoma*, *Dryophis*, &c. will be subdivided hereafter into two. Further, with regard to the aforesaid genera, the same observation as in Ornithology cannot be made, viz. that these are invariably genera belonging to temperate regions, disappearing entirely before we reach Tropical and Southern America. A part of the members of these genera are peculiar to the Neotropical (Tropical America) Ophidio-fauna; a part reach the Tropics in the old world, and a third part belong to the temperate portions of both hemispheres.

Taking the amount of similarity or dissimilarity of ornithic life as

a guide, Mr. Selater states the following primary divisions of the earth's surface :—

I. *Palæarctic Region* (Regio Palæarctica).

*Extent.*—Africa, north of the Atlas ; Europe ; Asia Minor ; Persia and Asia generally, north of the Himalaya Range ; upper part of the Himalaya Range (?) ; Northern China, Japan, and the Aleutian Islands. Approximate area of 14,000,000 square miles.

II. *Æthiopian or Western Palæotropical Region* (Regio Æthiopica).

*Extent.*—Africa, south of the Atlas Range ; Madagascar ; Bourbon ; Mauritius ; Socotra, and probably Arabia up to the Persian Gulf, south of 30° N. lat. Approximate area of 12,000,000 square miles.

III. *Indian or Middle Palæotropical Region* (Regio Indica).

*Extent.*—India and Asia generally, south of the Himalayas ; Ceylon ; Burmah, Malacca, and Southern China ; Philippines ; Borneo ; Java ; Sumatra and adjacent islands. An area of perhaps 4,000,000 square miles.

IV. *Australian or Eastern Palæotropical Region* (Regio Australiana).

*Extent.*—Papua and adjacent islands ; Australia ; Tasmania and Pacific Islands. An area of perhaps 3,000,000 square miles.

V. *Nearctic or North American Region* (Regio Nearctica).

*Extent.*—Greenland, and North America down to centre of Mexico. Area of perhaps 6,500,000 square miles.

VI. *Neotropical or South American Region* (Regio Neotropica).

*Extent.*—West India Islands ; Southern Mexico ; Central America, and whole of South America ; Galapagos Islands ; Falkland Islands. Estimated area of about 5,500,000 square miles.

The notices devoted to each region will show how great is the conformity which this most natural division and the definition of the limits of the regions exhibit in Herpetology.

I. *Palæarctic Region* (Regio Palæarctica).

Characteristic forms.—(*Calamaria*?) *coronella*, (*Tachymenis*?) *vivax*, (*Simotes*?) *diadema*, *Rhinechis*, *Zamenis*, *Chorisodon*, *Cœlopettis*, *Eryx*, *Pelias*, *Vipera*, *Echis*, *Cerastes*.

Form common to India.—*Trigonocephalus*.

This region is at once distinguished by the small number of generic forms and of species : great variety of amphibian life is produced only by the sun of the Tropics, and dependent upon a similar variety of the vegetative world. Where the soil is covered with social plants,

either trees or grasses, there we find an equal uniformity in the life of Reptiles, which uniformity is still more manifest in temperate zones.

North of 62° N. L. no Snake has hitherto been found; and thus the forty species which live within the boundaries of this region are very unequally distributed over an area of 14,000,000 square miles. We have on an average a single species to each 350,000 square miles. All the species are of small size, dusky colour, and of a timid disposition; by far the greater part belong to the *Colubrina*,—their ratio to the *Boina* being that of 20 : 1, and to the *Viperina* of 4 : 1.

The identity of the creation in the different provinces of this region may be represented by the following examples, which will forcibly show the reason why I unite the Æthiopian shores of the Mediterranean especially with this region, instead of considering Spain and Portugal as a part more approximate to Africa than to Europe, as Schlegel did. *Eryx jaculus* may be traced from the eastern half of the shores of the Mediterranean, through the temperate part of Asia, into the south of Siberia; *Tachymenis vivax* from Egypt northwards to Hungary. Further, the genus *Zamenis* is one of the most characteristic types of this region,—*Z. atrovirens* being spread along the northern shores of the Mediterranean, *Z. Cliffordii* along the southern ones, *Z. hippocrepis* and *Dahlia* going entirely round this inland sea, *Z. ventrimaculatus* reaching from Egypt through Kurdistan to the south of the Himalaya, and, finally, *Z. caudolineatus* being a native of Kurdistan. *Coronella austriaca*, more common in the parts north of the Alps, is replaced in the south by *C. girundica*, in the north of Africa by *C. cucullata*. *Tropidonotus natrix*, reaching into the heart of northern Asia, is represented in North Africa by *Trop. viperinus*. *Trop. hydrus* appears to range still further towards the west of Asia. *Coluber quadrilineatus*, common on the northern shores of the Mediterranean and on its eastern islands, is again found in the north of China. *Cœlopeltis*, a true native of Northern Africa, is found in the Pyrenean peninsula. *Pelias berus* inhabits Ireland, Scotland, England, Norway, Sweden, and all the central parts of Europe, and is again found on the shores of the Lake of Baikal.

The viperine snakes of this region exhibit generic differences on the north and south of the Mediterranean,—on the former we find *Pelias* and *Vipera*, on the latter *Echis* and *Cerastes*. But the above-stated facts sufficiently show that the lower part of Egypt should be united with this region as well as Algiers; and I am surprised that Mr. Sclater leaves it uncertain whether he includes that part of Egypt or not. A few true African forms intrude themselves into the African parts of the region; *Echidna atricauda* and *mauritanica* are found in Algiers, and *Naja haje*, following in many varieties the course of the African rivers, comes down with the Nile and reaches the Delta. That *Echis carinata*, more frequently met with in the East Indian continent, is also found in Egypt, is a curious fact stated by Duméril and Bibron (vii. p. 1448); and as Schlegel mentions it as being found also in the deserts south of the Caspian Sea, it quite corresponds to the aforesaid range of *Zamenis ventrimaculatus*.



The genus *Trigonocephalus*, which has its focus in the Indian region, is curiously enough represented by a single species (*T. halys*) in the southern parts of Siberia, reaching to the north of the Caspian Sea. Thus, of all the genera peculiar to the Indian region, *Trigonocephalus* advances furthest northward, emitting moreover another species (*T. Blomhoffi*) to Japan.

Japan, that outpost of the Palæarctic region, is not in the same way peopled with Palæarctic snakes as we find it with Palæarctic forms of other classes of the animal kingdom. As to its Herpetology in general, it is truly a debateable ground between the Palæotropical and Indian Amphibio-faunæ: but as regards the *Ophidia*, it belongs entirely to the Indian region; for the present, at least, we do not know one Japanese snake which is also found in the Palæarctic region, or even only belonging to one of its peculiar generic forms.

## II. *Æthiopian or Western Palæotropical Region (Regio Æthiopica).*

Characteristic forms.—*Hortulia, Sanzinia, Pelophilus, Casarea, Calabaria, Homalosoma, Psammophylax, Heteronotus, Prosymna, Meizodon, Psammophis, Dasypeltis, Bucephalus, Hapsidophrys, Langaha, Simocephalus, Lamprophis, Alopecion, Lycophidion, Metoporphina, Boodon, Holuropholis, Naja haje, Cyrtophis, Elaps? hygiæ, Dendraspis, Causus, Sepedon, Atractaspis, Clotho.*

Forms common to other regions. — *Philodryas, Chrysopelea, Ahatulla, Dryophis, Leptodeira, Dipsas, Dipsadoboa.*

We now enter a tropical region, and immediately find forms of gigantic magnitude, vast variety and vivacity of coloration, and a great multiplication of the number of generic forms and species, although only the southern part of this truly continental region has been examined in a satisfactory manner: it is not many years since the borders of Western and of part of Eastern Africa were explored; and the great advance of zoological knowledge, produced by this first search, promises the most extensive results to those daring attempts to cross a continent which, instead of being a continuous burning desert, contains a new world of vegetable and animal life. An enumeration of the reptiles of Western Africa, by Dr. Gray (P.Z.S. 1858, p. 155 *et seq.*), shows how greatly our knowledge of the Herpetology of that country has been enlarged in the course of a few years. Therefore I hope that the ratio here given of the geographical area and distribution of the *Ophidians* will only be a proof of the distance between our present knowledge and that of the coming decennium. Taking the area of this region at 12,000,000 square miles, and the number of species of Snakes contained therein at 80, we have on an average a single species to every 150,000 square miles, or  $2\frac{1}{3}$  species to the same area for which we found only one in the Palæarctic region.

The number of *Colubrina* is again predominant, but is to that of the *Boina* only as 8 : 1, and to that of the *Viperina* as 11 : 1; the proportional number of the *Boina* therefore is increased, that of the *Viperina* diminished. We must observe, first, as a peculiarity of

this region, that at present there is not one species known of the genus *Tropidonotus*. Schlegel believed he found its representative in *Dasypeltis scaber*; but a snake living on trees, devouring birds' eggs, the shells of which it breaks by its gular teeth, with an irregular arrangement of the lateral scales, is a form quite peculiar in itself, and peculiar to this region. Highly interesting is the fact, that more than one-third of the genera live on trees, which ratio is never met with in any of the other regions: there we find a member of the family of *Lycodontidae* (a family which contains either Ground-snakes, or forms only slightly approaching to that structure which indicates the capability of climbing trees) entirely transformed into a very Tree-snake (*Simocephalus*). There we find Tree-snakes with perforated fangs in front (*Dendraspis*). The African species of *Naja* (*N. haje*), so closely allied to the Indian *Cobra de Capello*, is to be considered as a Tree-snake as well as Ground-snake, whilst *N. tripudians* never appears to climb trees. But the Indian and the African species offer a similar series of varieties; and it would be, in many cases, very difficult to assign one of those varieties, if of unknown origin, to the right species, without the single character of the sixth upper labial shield. The question whether those varieties really are species is not yet decided. Every large collection should obtain as many specimens as possible of both forms, with the most accurate accounts of their localities. There are about 70 specimens in the collection of the British Museum; but even with this number I was unable to distinguish separate species within accurately limited boundaries.

Another peculiarity of this region is the abundance of Snakes provided with longer front teeth, or *Lycodontidae*; and it agrees also in this respect with India: in fact, the western and middle Palæotropical regions equally partake of this family, each region producing a form with entire subcaudal plates. *Venomous Colubrina* here form a great portion among the *Ophidia*, a greater one than the true *Viperina*; and they also exhibit quite a peculiar group, namely such *Colubrina* as are provided with permanently erect and perforated fangs (*Dendraspis*, *Atractaspis*). Our knowledge of the whole region is very limited, as also is the case with the large island connected with it, Madagascar. The following Snakes are known belonging to its fauna:—

- Sanzinia. Pelophilus.*
- Heterurus gaimardii* and *arctifasciatus.*
- Psammophis sibilans*, var.
- (*Herpetodryas bernierii.* Isle de France.)
- Herpetodryas quadrilineatus.*
- Enicognathus rhodogaster.*
- Philodryas miniatus* and *goudotii.*
- Ahætulla lateralis. Langaha.*

None of these Snakes, except *Psam. sibilans*, have been found on the continent of this region, or in any other part of the globe; and it may be a question, as already suggested by Schlegel, whether such a separate and peculiar fauna as that of Madagascar might not furnish



a reason for establishing a separate region, small as regards the geographical area, rich as to its animal and vegetative life, if the still hidden parts should prove to be as peculiar as that which we know. *Sanzinia*, *Pelophilus*, and *Langaha* constitute genera not represented by other species in other provinces. If we look at the forms common to other regions, we find them all to be Tree-snakes, having the allied species spread over the tropical regions in the west or east.

### III. Indian or Middle Palæotropical Region (Regio Indica).

Characteristic forms.—*Chersydrus*, *Acrochordus*, *Xenodermus*, *Python*, *Cliftia*, *Cusoria*, *Gongylophis*, *Clothonia*, *Cylindrophis*, *Calamaria*, *Rhabdion*, *Brachyorrhos*, *Aspidura*, *Haplocercus*, *Elapoidis*, *Trachischium*, *Oligodon*, *Simotes*, *Ferania*, *Homalopsis*, *Phytolopsis*, *Tropidophis*, *Hypsirhina*, *Fordonia*, *Raclitia*, *Miralia*, *Xenodon* (with keeled scales), *Gonyosoma*, *Euophrys*, *Psammodynastes*, *Passerita*, *Leptognathus?* *indicus*, *Amblycephalus*, *Pareas*, *Hologerrhum*, *Lycodon*, *Tetragonosoma*, *Leptorhyton*, *Ophites*, *Cercaspis*, *Cyclocorus*, *Hamadryas*, *Bungarus*, *Naja tripudians*, *Elaps* (with thirteen rows of scales). HYBRIDÆ: *Trimesurus*, *Parias*, *Megæra*, *Atropos*, *Trigonocephalus*, *Daboia* (except *D. xanthina*, Gray).

Forms common to other regions.—*Rhabdosoma*, *Cerberus*, *Coluber*, *Elaphis*, *Spilotes*, *Coryphodon*, *Chrysopelea*, *Dendrophis*, *Dryophis*, *Eudipsas*, *Dipsas*, *Dipsadomorphus*, *Echis*.

Whether the Indian region really is richer in peculiar generic and specific forms than the African one, or whether this difference is caused only by our more extended knowledge of the former, the future will show; for the present it is not even rivalled by the South American region: for, taking the area of the Indian region at 4,000,000 square miles and the number of species of Snakes at 240, we have on an average a single species to every 17,000 square miles, or 21 species to the same area for which we found only one species in the Palæarctic region, and 9 for the same area in the Æthiopian. The ratio between the different sections of the Snakes shows that, in comparison with Africa, the relative number of *Boina* is diminished, their ratio to the *Colubrina* being 1 : 12 : but that of the Viperine Snakes has as much increased as the absolute one; each seventh species belongs to this truly venomous section (1 : 6). Quite a new form of snakes enters into this fauna—the *Hybridæ*: organized for living in the sea, they are seldom found on the coasts, and we do not yet know whether they approach the beach occasionally, or when obliged by certain physiological functions. But being constant inhabitants of the sea, they are endowed with active as well as with passive locomotion to enable them to traverse greater distances than the snakes living on dry ground; and therefore it is not to be wondered at that we find not only the section in general, but the single species spread far beyond its actual native ground—namely the sea between the southern coast of China and the northern one of New Holland—and extending to

the south of the Australian region, and far between the tropical islands of the Pacific. A certain proximity to land appears to be necessary for their life, as they are never found in those wide marine spaces which are void of islands, not being able by traversing them to spread into the Neotropical or Æthiopian regions\* ; and thus they may be brought as properly as marine birds into the statement of the ratio between the number of species and the area of dry land. A second form, quite peculiar to this region, are Snakes covered with granular tubercles, *Chersydrus*, *Acrochordus*, *Xenodermus* ; without being venomous, they approach the *Hydridae* by the genus *Chersydrus*, an inhabitant of rivers and their mouths, and with an organization like that of true Sea-snakes. As the family of the *Lycodontidae* must be assigned to the Indian and African region, each exhibiting different genera, so that of the *Calamariidae* should be divided in the same way between the Neotropical and this region, whereas *Homalosoma* and two species of *Rhinostoma* may perhaps be hereafter separated from this family. The above-mentioned genera of *Calamariidae* are highly characteristic ; and the very aberrant forms which abound in India are here represented by a genus of this family having no palatine teeth. Those intermediate forms between the well-proportioned structure of the family of *Colubridae* and the excessively slender one of the true Tree-snakes, which I unite in one family of *Dryadidae*, and which are so common in the Neotropical region, are feebly represented by some species of *Cyclophis* and *Gonyosoma*. The genus *Ahatulla* is here represented by *Dendrophis*—one species (*D. picta*) extending to New Guinea, another (*D. punctulata*) to Australia. *Dryophis* is found in the Neotropical region as well as in the Indian one, but the species of both regions differ in dentition ; the African species (*D. Kirtlandii*) agrees with the South American ones ; finally, *Passerita* is only limited between the boundaries of the East Indies. If we exclude the *Hydridae*, the number of venomous *Colubrinae* is far surpassed by that of the *Viperina* ; and all the latter exhibit the peculiarity of having a pit on the side of the face, which is also found in the representatives of the New World, not in those of Africa. Ceylon offers a remarkable exception, producing a form without such a pit.

Among those large islands which are connected with the middle Palæotropical region, none offer forms so different from those of the continent and the other islands as Ceylon : it might be considered the Madagascar of the Indian region. We not only find there peculiar genera and species, not again to be recognized in other parts, but even many of the common species exhibit such remarkable varieties, as to afford ample means for creating new nominal species.

1. *Calamaria* and *Elaps* are not represented in this island.

\* During the printing of this paper, I first heard of Sea-snakes seen near the western shores of America. They were observed in considerable numbers by M. Sallé and Mr. Salvin, at different times, from steamers crossing the Bay of Panama, and were about the size of an eel. I have not the slightest reason to doubt the credibility of the observers ; but so long as we have not obtained them it will always be a question whether the animals seen were Snakes or not.

2. The following species are common to Ceylon and the other parts of the region, the Ceylonese specimens exhibiting no remarkable variation:—*Simotes Russellii*, *Coryphod. Blumenbachii*, *Ablabes collaris*, *Chrysopelea ornata*, *Dendrophis picta*, *Tropidonotus stollatus*, *Lycodon aulicus*, *Naja tripudians*.

3. Ceylonese specimens of the following species always exhibit one and the same variation:—*Simotes purpurascens*, *Tropidonotus quincunciatus* (two Ceylonese varieties), *Tropidonotus chrysgargos*, *Passerita mycterizans*, *Bungarus fasciatus*.

4. The following species are peculiar to Ceylon; but representatives of the genera are found in other parts of this region:—*Cylindrophis maculata*, *Oligodon sublineatus*, *Cynophis helena* (appears to be the representative of *Elaphis subradiatus*), *Cyclophis calamaria*, *Dipsadomorphus ceylonensis* (is the representative of *D. trigonatus*), *Trimesurus ceylonensis* and *nigro-marginatus*, *Megæra trigonocephala*, *Trigonocephalus hypnalis*, *Daboia elegans*.

5. Finally, the following genera, exhibiting entire subcaudal plates, are peculiar to Ceylon:—*Aspidura*, *Haplocercus*, *Cercaspis*.

If we look at the forms of this region, common to other ones, we see that most of them belong to Schlegel's two genera, *Coluber* and *Dipsas*. The separation of the former into smaller natural genera has not yet been effected in such a way as to satisfy the systematist; and therefore it is the less suited for a consideration of its geographical distribution (*Zamenis* excepted). Nearly the same is the case with the genus *Dipsas*; and even if we separate single forms more aberrant from the general type, there remain a great many species which, comprised in one genus, do not give us the idea of a cosmopolitan genus, but of a "tropicopolitan." Species of *Rhabdosoma* are found in the Neotropical, a single species of *Cerberus* and *Dendrophis* in the eastern Palæotropical region; the geographical distribution of *Dryophis* and *Echis* has been stated above.

I may add a few words to prove what I have before mentioned, viz. that the Snakes of Japan belong to the fauna of the Indian region. The following species from these islands are known\* :—

1. *Tropidonotus tigrinus*, and

2. *T. Vibakari* belong to a cosmopolitan genus; but the former, being also found near Ningpo in China, belongs to a group of this genus, which is formed solely by species native in India; and the second species is the single type of another peculiar group (see Catal. of Colubr. p. 60).

3. *Coluber conspicillatus*,

4. *Elaphis quadrivirgatus*, and

5. *Elaphis virgatus*, exhibit not only a remarkable similarity in general habits, and in the system of coloration, with other true East Indian Snakes (*Elaphis subradiatus*, &c.), but the two latter are also found on the Indian continent, in China, south of the Yellow River.

6. *Trigonocephalus Blomhoffii* belongs to a genus with four species in the East Indies and one in the northern parts of Asia.

\* Cf. Schlegel, 'Fauna Japonica'—"Reptiles."



How greatly different the view gained by a consideration of the geographical distribution of the Batrachians is, we shall see in the Second Part of this paper. Our knowledge of the Herpetology of Celebes is yet too limited to allow a satisfactory attempt to compare its fauna with that of other parts.

#### IV. *Australian or Eastern Palæotropical Region* (Regio Australiana).

Characteristic forms.—*Morelia*, *Liasis*, *Nardoa*, *Enygrus*, *Bolyeria*, *Myron*, *Glyphodon*, *Diemansia*, *Hoplocephalus*, *Pseudechis*, *Pseudonaja*, *Brachysoma*, *Vermicella*, *Acanthophis*.

Forms common to other regions.—*Cerberus*, *Dendrophis*, *Dipsas*, *Hydridæ*.

What I have said in the beginning of my notices on the Æthiopian region I can as justly repeat respecting this part of the globe, the borders only of which are known to us; so that the proportionate numbers here given will be far from the truth, and can be considered only as proportionate to our present knowledge. If we allow 50 species as peculiar to this region, and take the area of dry land at 3,000,000 square miles, we have on an average a single species to every 60,000 square miles, or  $2\frac{1}{2}$  species for the same area in the Æthiopian; but the Indian region is richer, giving  $3\frac{1}{2}$  species for the same area in which we have only one in the Australian.

We find a peculiar character of this region in the ratio between the numbers of species in the different sections of the Snakes. Two-thirds are venomous snakes—a disproportion not to be found again in any of the other regions, where the number of innocuous snakes always greatly predominates; secondly, two-thirds of the non-venomous snakes are *Boidæ*; thirdly, there is only one genus (*Acanthophis antarctica*) belonging to the tribe of *Viperina*, the whole of the other venomous snakes being constituted by *Columbrina* with grooved fangs. We know only six non-venomous *Columbrina* from New Holland, two of which (*Coronella australis* and *Tropidonotus picturatus*) belong to cosmopolitan genera, the third (*Dipsas fusca*) to a tropicopolitan genus, the fourth and fifth (*Dendrophis punctulata* and *Cerberus australis*) to East Indian ones: for the sixth (*Myron Richardsonii*) a separate genus was established; but it is closely allied to the East Indian *Hypsirhina*. The genus *Elaps*, represented by a different form, *Vermicella*, is so far from being capable of being united with the East Indian forms, that it is nearer to those of the Neotropical region. Thus, if we except three species and the *Hydridæ*, which are subjected to totally distinct physical conditions, we have in the eastern Palæotropical region a fauna of Ophidians as widely different from the nearest one of the East Indies as from all the other ones. It must be mentioned, that there is no snake known for the present from New Zealand. I say, for the present; for, not many years since, a total absence of Serpents in all the numerous isles of the Pacific Ocean was believed in.

## V. Nearctic or North American Region (Regio Nearctica).

Characteristic forms.—*Charina*, *Wenona*, *Conopsis*, *Conocephalus*, *Carphophis*, *Osceola*, *Ninia*, *Lodia*, *Sonora*, *Rhinochilus*, *Tantilla*, *Simotes*? *coccineus*, *Ischnognathus*, *Helicops*, *Farancia*, *Dimades*, *Abastor*, *Virginia*, *Contia*, *Pituophis*, *Cenchrus*, *Crotalophorus*, *Uropsophus*, *Crotalus*.

Forms common to other regions.—*Heterodon*, *Coluber*, *Coryphodon*, *Herpetodryas*, *Cyclophis*, *Elaps*.

There is some difficulty in stating the southern boundary of this region; the Tropical fauna advances along the Isthmus of Panama, and, extending over the again expanding part of Southern Mexico, it is gradually mixed with the Arctic fauna. And in these parts the fauna of the same latitude is the more mixed on account of the great differences of the elevation above the level of the sea, and the resulting great variety of climate in a small space; but as the climate gradually assumes the tropical character, so also do vegetative and animal life. Nevertheless we have in the New World two entirely different creations, radiating from the system of the Mississippi in the north, and from that of the Amazon in the south; and in each of those smaller provinces situated on the boundary between both regions, it will be a question whether the larger number of its species belong to northern or southern forms. As far as we are able at present to judge, the tropic of Cancer may be considered as the boundary. No Snake is to be found north of 60° N. lat.,—a latitude where in the Palæarctic region *Pelias berus* exists. But taking 6,500,000 square miles as the amount of the whole dry land in this region, and allowing seventy-five\* species as peculiar to it, we have one species to every 87,000 square miles, or four species to the same area for which we found only one in the Palæarctic region. Thus this region indicates a much greater degree of intensity of species than the Palæarctic region; but if it be stated that it also surpasses the Æthiopian region, this I consider as not an established fact, but only an appearance caused by the circumstance that North America has been much more fully explored than Africa. Even then, if we consider (according to Dr. Gray's system) *Charina* and *Wenona* to be *Boidea*, the ratio of this section to the number of *Colubrina* is very small (1 : 18), the ratio between *Viperina* and *Colubrina* being large (1 : 5); in this respect this part of the fauna quite agrees with the same part of the Old World.

Among the non-venomous *Colubrina* the two families of *Calamariidae* and *Natricidae* offer the most generic and specific forms. The type of *Heterodon* is a North American form; but one species is also found in South America.

\* Without summing up the number of all the North American species described since the publication of the 'Catalogue of North American Reptiles' by Baird and Girard, 1853, I only mention that they describe therein 119 species. What I think of such species is shown by the synonymy of the North American Snakes in my Catalogue.

*Colubrina* with grooved fangs in front can hardly be considered as pertaining to this region, only two species of *Elaps* reaching into the most southern parts. The Viperine Snakes are represented by most peculiar forms, all belonging to the family with a pit on each side of the face: they all exhibit entire subcaudal shields (at least on the anterior part of the tail).

#### VI. Neotropical or South American Region (Regio Neotropica).

Characteristic forms.—†*Epicrates*, *Xiphosoma*, †*Corallus*, †*Boa*, *Eunectes*, \**Chilabothrius*, \**Ungalia*, *Tortrix*, *Streptophorus*, *Homalocranium*, *Elapomorphus*, *Elapocephalus*, \**Arrhyton*, *Liophis*, *Stenorhina*, *Erythrolamprus*, \**Hypsirhynchus*, *Xenodon* (with smooth scales), *Uranops*, *Hydrops*, *Hygina*, \**Gerarda*, \**Hipistes*, *Ficimia*, †*Dromicus*, *Psammophis*? *lineatus*, *Thammodynastes*, *Dipsas*? *cenchoa*, *Rhinobothryum*, *Leptognathus*, *Tropidodipsas*, *Scytale*, *Oxyrhopus*, \**Elaps* (with fifteen rows of scales), †*Craspedocephalus*, *Lachesis*.

Forms common to other regions.—*Rhinostoma*, *Rhabdosoma*, *Tachymenis*, *Tomodon*, *Heterodon*, *Spilotes*, *Coryphodon*, †*Herpetodryas*, †*Philodryas*, †*Ahætulla*, †*Dryophis*, *Leptodeira*, *Eudipsas*, *Dipsadomorphus*, *Dipsadoboa*.

If the number of species duly attributable to this region be reckoned at about 150, and its geographical area at 5,500,000 square miles, we have a single species to every 36,000 square miles, or nearly  $2\frac{1}{2}$  species to the same area for which we found a single one in the Northern region. As for intensity of species, this region is far surpassed by the East Indies, exhibiting only half as many species for the same area, and therefore showing itself proportionally far less productive of snakes than of birds. This fact will be very near the truth, as we know nearly equal portions of both regions. In the ratio of the different sections of snakes, South America does not agree with any other region, showing a ratio between *Boina* and *Colubrina* = 1 : 8, and between *Viperina* and *Colubrina* = 1 : 15. All the *Boina* have only a single row of subcaudal plates, whilst the other tropical regions exhibit such species with entire subcaudals as well as with two-rowed. Among the Colubrine Snakes, it is rich especially in those intermediate forms without prominent characters, the systematical arrangement of which is far from being complete.

Another character of the Region is, that true *Lycodontidæ* are wanting: they are replaced by *Scytale* and *Oxyrhopus*, in many respects similar to the East Indian *Lycodontidæ*, and forming a connecting link between these and the *Dipsadidæ*. All the venomous *Colubrina* belong to the genus *Elaps*, differing from the East Indian species by having fifteen rows of scales and another system of coloration; one or two species range into the southern parts of the former region. Finally, all the *Viperina* exhibit a pit on the side of the face, two-rowed subcaudal plates, and the head covered with scales, being thus more closely allied to the greater part of the East Indian genera than even to those forms which we meet with in North America;



One Viperine Snake with a rattle, *Crotalus horridus*, ranges into this region; but being also found in the more northern parts, and having other relations in North America, it must be reckoned among those of the latter region.

Of the forms common to other regions there are found—

1. In the Æthiopian region, species of *Rhinostoma*, *Philodryas*, *Ahætulla*, *Dryophis*, *Leptodeira*, *Dipsadoboa*. In fact all the species belonging to these genera show severally, according to each different region, such different characters as may be hereafter considered to be generic, if they are again to be found in other species of the same region; and I wish therefore to point out a much greater difference between both regions than might appear by the number of forms mentioned as common. For instance, the South American species of *Rhinostoma* exhibit a posterior grooved tooth; in *Rhinostoma cupreum* of Africa I found the same tooth not grooved; if *Rh. occipitale* of Hallowell, from Western Africa, or other species hereafter to be discovered, should prove to have also smooth teeth, I should consider it to be a character sufficient to separate the Neotropical species from those of the western Palæotropical region. Not knowing the species of *Philodryas* from Madagascar, I refrain from giving my opinion in respect to them.

2. In the Indian region, species of *Rhabdosoma*, *Tomodon*, *Spilotes*, *Coryphodon*, *Dryophis*, *Eudipsas*, *Dipsadomorphus*. I have already pointed out that South America exhibits in more than one respect similarities with the middle Palæotropical region; and thus, excepting those forms which are represented in both regions by different genera, we have two genera truly common to them, *Rhabdosoma* and *Coryphodon*. The other genera I reckon of the same account as those mentioned as common to the Æthiopian region.

3. In the Palæotropical region, one species of *Tachymenis*.

4. In the Nearctic region, species of *Heterodon*, *Herpetodryas*, *Coryphodon*. The first two genera are limited to the New World,—one exhibiting more species in the northern part, the other more in the south.

The Ophidians decidedly show that the West Indies are referable to the Neotropical region only. Hardly one species § is common to them and to the Nearctic region, and only the genus *Herpetodryas* might be considered such. On the other hand, many Southern continental species are again found in the West Indies; and how many generic forms are common to both, the number of genera marked above with a cross (†) will represent. The genera peculiar to the West Indies, and marked with an asterisk (\*), do not express a common peculiar character; and some of them are founded on relatively slight characters.

§ Hallowell mentions *Ischnognathus Dekayi* as found in Jamaica (Proc. Ac. Nat. Sc. Philad. 1856, p. 237).

SCHEMA OPHIDIORUM DISTRIBUTIONIS GEOGRAPHICÆ.

CREATIO NEOGEANA.

12,000,000 square miles, } =  $\frac{1}{53,000}$ .  
 225 species, }

ORBIS TERRARUM.

45,000,000 square miles, } =  $\frac{1}{70,000}$ .  
 635 species, }

CREATIO PALÆOGEANA.

33,000,000 square miles, } =  $\frac{1}{80,000}$ .  
 410 species, }

V.

**Regio Nearctica,**  
 6,500,000 square miles,  
 75 species,  
 =  $\frac{1}{87,000}$ .

I.

**Regio Palæarctica,**  
 14,000,000 square miles,  
 40 species,  
 =  $\frac{1}{350,000}$ .

VI.

**Regio Neotropica,**  
 5,500,000 square miles,  
 150 species,  
 =  $\frac{1}{36,000}$ .

II.

**Regio Æthiopica,**  
 12,000,000 square miles,  
 80 species,  
 =  $\frac{1}{150,000}$ .

III.

**Regio Indica,**  
 4,000,000 square miles,  
 240 species,  
 =  $\frac{1}{17,000}$ .

IV.

**Regio Australiana,**  
 3,000,000 square miles,  
 50 species,  
 =  $\frac{1}{60,000}$ .

The above Schema is made to accord with Mr. Sclater's Schema of the geographical distribution of Birds; but in both schemes the calculations made as to the number of square miles to one species cannot be looked upon even as attempts at approximations, in those regions of which a part only has been explored by naturalists. Thus the large space of Central Asia, between 250° and 300° W. long. and between 35° and 50° N. lat., is quite unknown—a space of about 3,000,000 square miles, which cannot be justly taken into account; and then we should have a ratio of 1 : 275,000. In the Æthiopian and Australian region, at least two-thirds of the area mentioned being unknown, we should have on the average a single species to 50,000 square miles for the former, and to 20,000 square miles for the latter region. In this way we arrive at least at a more accurate idea of the series in which the regions follow one another as to their respective richness in forms:—

1. Indian region 1 : 17,000.
2. Australian region 1 : 20,000 (instead of 1 : 60,000).
3. South American region 1 : 36,000.
4. Æthiopian region 1 : 50,000 (instead of 1 : 150,000).
5. North American region 1 : 87,000.
6. Palæarctic region 1 : 275,000 (instead of 1 : 350,000).

Thus from the consideration of the geographical distribution of Snakes, we are obliged to acknowledge the views of the primary divisions of the earth's surface given by Mr. Sclater as those most natural. I have endeavoured always to state those facts which apparently contradict this view, as well as those which favour it; but, by stating the former, I intend rather to direct the attention of the systematist to such less satisfactory results of his exertions, than to destroy the idea of primary ontological divisions. As, however, we do not know one species of Snakes extending fully over two regions, and as we find each region occupied by a majority of peculiar genera, we come to the inevitable conclusion that these different forms of Snakes were created in the different parts of the world where they are now found; but it would be a too precipitate inference to maintain the same for all other species of the animal kingdom. As I said in the beginning of this paper, Snakes form a most stationary tribe among animals; but other animals are subjected to internal or external agencies by which they are necessarily spread, in a longer or shorter lapse of time, beyond their primary boundaries; and it is a great mistake, in such instances, not to admit the identity of species, even though it be modified into a climatic variety. How the Batrachians are related in this respect, and what are the most natural divisions of the earth's surface as to this order of Reptiles, will be the subject of the Second Part of this paper.